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Paper [2.2]

Toxicity and uptake of xenobiotic organic compounds in the presence of C₆₀ nanoparticles

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The role of C₆₀ nanoparticles as contaminant carriers was studied in a series of toxicity and uptake studies with zebrafish (*Danio rerio*), crustacean (*Daphnia magna*), and algae (*Pseudokirchneriella subcapitata*). Model compounds were radiolabelled (¹⁴C) phenanthrene and pentachlorophenol (PCP). The C₆₀ particles were suspended in distilled water through a 2-months period of vigorous stirring, yielding a suspension of aggregates of C₆₀ referred to as nC₆₀. Daphnids and algae were exposed to ¹⁴C-labelled phenanthrene or PCP as single substances and in mixtures with 6-8 mg/l nC₆₀. In a separate series of experiments, the uptake of phenanthrene/PCP as single compounds and in mixtures with nC₆₀ was studied in daphnids and zebrafish. For daphnids exposed to phenanthrene an apparent decrease in toxicity was observed (Fig. 1), however, it was found that also phenanthrene sorbed to nC₆₀ contributed to immobilization of daphnids. The toxicity increased about three times when nC₆₀ was present in algal mixture studies with phenanthrene. Thus, it was found that EC₅₀-values decreased from 720 µg/l for the single compound to 225 µg/l for the mixture phenanthrene/nC₆₀ when results were expressed as water phase concentration (i.e., taking sorption to nC₆₀ into account). The presence of nC₆₀ did not influence the toxicity of PCP significantly in algal and daphnia tests. A rapid uptake of phenanthrene was observed in studies where *D. magna* was exposed to sub-lethal concentrations of phenanthrene/nC₆₀ mixtures and the presence of nC₆₀ resulted in a higher steady-state concentration of phenanthrene in exposed animals. The higher concentration may, however, be due to phenanthrene sorbed to nC₆₀ residing in the digestion tract of the daphnids, as no transfer to clean water was included in these experiments. For PCP no differences in uptakes could be observed due to the presence of nC₆₀. For bioaccumulation studies with zebrafish, a whole-body concentration of 150-200 µg/kg b.w. was observed for both compounds during the 28-d feeding with fish food mixed with nC₆₀ and phenanthrene/PCP. After this feeding was stopped, the compounds could not be traced in the fish after 4 days of feeding with ordinary fish food.

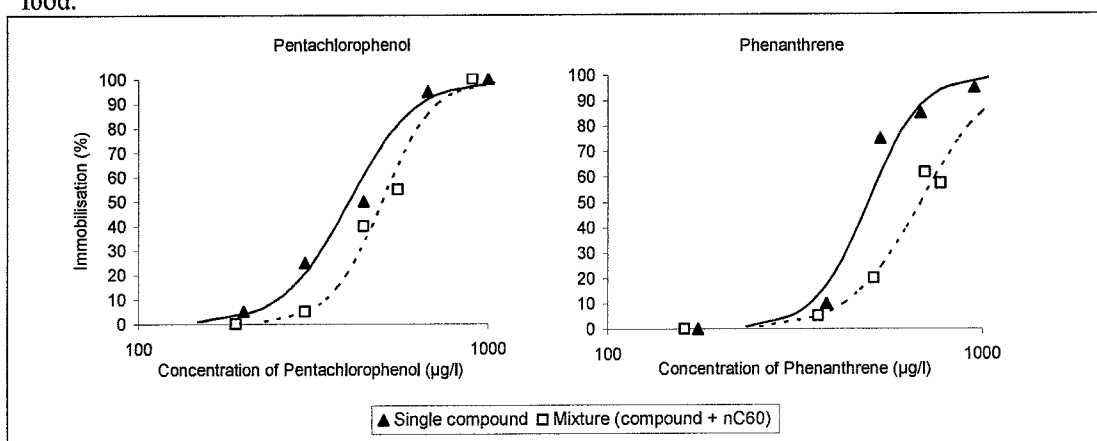


Fig. 1. Concentration-response curves for immobilization of *Daphnia magna* exposed for 48-h to phenanthrene and pentachlorophenol with and without addition of nC₆₀.